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IS 15558 (2005): Mini domestic water heater for use with LPG [MED 23: Domestic and Commercial Gas Burning Appliances]

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Indian Standard

MINI DOMESTIC WATER HEATER FOR USE WITH LPG — SPECIFICATION

ICS 97.100.20

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

February 2005 Price Group 6

Domestic and Commercial Gas Burning Appliances Sectional Committee, ME 23

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Domestic and Commercial Gas Burning Appliances Sectional Committee had been approved by the Mechanical Engineering Division Council.

In preparing this standard, assistance has been derived from BS : 4104-1967 'Specification for catering equipment running on liquefied petroleum gases'; BS : 5386, Part 2 : 1981 'Mini water heaters (2nd and 3rd family gases)' and 5386, Part 5 : 1988 'Gas burning appliances: Part 5 Specification for gas burning instantaneous water heaters with automatic output variation (2nd and 3rd family gases)'. It is for instantaneous product of hot water for domestic use, of nominal useful out put less than 25 kW (1 kcal/h = 1.162 78 W).

This standard is one of a series of Indian Standards on various domestic and commercial gas burning appliances (pressure type) used with liquefied petroleum gases (LPG). General requirements of this equipment are covered in IS 5116 : 1996 'General requirements for domestic and commercial equipment for use with LPG (*third revision*)', which is a necessary adjunct to this standard. Should, however, any deviation exist between the requirements given in IS 5116 and those given in this standard, provisions of the latter shall apply. Other standards published so far in the series are IS 4246 : 2002 'Domestic gas stoves for use with liquefied petroleum gases — Specification (*fifth revision*)', IS 4473 : 2002 'Domestic gas ovens for use with liquefied petroleum gases (*first revision*)' and IS 11480 : 1998 'Domestic grillers for use with liquefied petroleum gases — Specification (*first revision*)'.

Specification for bulk water heater for use with liquefied petroleum gases (LPG) covered in IS 5776 : 1988 'Bulk water heaters for use with LPG (*first revision*)'.

The composition of the Committee responsible for the formulation of this standard is given in Annex E.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be same as that of the specified value in this standard.

AMENDMENT NO. 1 OCTOBER 2007
TO
IS 15558 : 2005 MINI DOMESTIC WATER HEATER FOR USE WITH LPG — SPECIFICATION

(*Page* 2, *clause* **4.1.11**) — Substitute '20^{+1}_{-2} min' *for* '20 min'.

(*Page* 2, *clause* **5.2**, *line* 1) — Substitute 'copper and copper alloy forged and cast parts' *for* 'copper and copper alloy parts'.

(*Page* 2, *clause* **6.4**) — Substitute '½ BSP thread' *for* 'BSP thread'.

(*Page* 3, *clause* **9**) — Substitute the following for the existing clause:

'**9 FLAME FAILURE DEVICE**

9.1 The appliance shall have a flame failure device, controlling the admission of gas to the main burner and possibly to any ignition pilot. The provision given in **14.1** of IS 5116 shall apply.

9.2 The requirements of flame failure device shall be checked by the method given in Annex E.'

(*Page* 3, *clause* **11**, *line* 4) — Substitute '95^{0}_{-10} °C' *for* '95 °C'.

(*Page* 3, *clause* **13.1.1**) — Insert the following at the end:

'Test room conditions shall apply for thermal efficiency, combustion, gas consumption and resistance to draught. All other performance requirements may be tested at actual room conditions.'

(*Page* 3, *clause* **15**, *line* 1) — Substitute 'All water carrying parts of the appliance individually and when assembled to form the water circuit' *for* 'The water circuit'.

(*Page* 3, *clause* **18**, *line* 3) — Substitute '± 8 percent' *for* '± 5 percent'.

(*Page* 4, *clause* **25**) — Insert following new clause and renumber the subsequent clauses:

'26 HOT WATER OUTPUT TEST

Ignite the burner at gas inlet pressure 2.452 to 3.432 kN/m^{3} (25 to 35 gf/cm^{2}) and allow the heater to attain thermal equilibrium with the taps fully opened and with the burners operating at the maximum consumption. Adjust the water control in such a way that the difference between temperatures of inlet and outlet water is 25°C ± 2°C. Turn the heater off and do not disturb any of the settings. Now restart the appliance and collect the outlet water in a container during which inlet and outlet water temperatures shall be measured at an interval of every two minutes. With taking care that the measuring devices do not cause any thermal loss. At the end of 10 minutes, close the hot water tap. Measure the total hot water collected and calculate water rate in l/min. During the test, if temperature goes beyond specified limits then test shall be discarded. Water rate should be within ± 5 percent of the value declared by the manufacturer.'

[*Page* 4, *clause* **27.1**(j), *line* 2] — Insert word 'adjustable' *after* 'if'.

(*Page* 5, *Annex* A, *clause* **A-1**, *line* 3) — Delete 'a'.

(*Page* 5, *Annex* B, *clause* **B-1.2**, *formula*) — Substitute 'H = calorific value of LPG, in kcal/l' *for* 'H = calorific value of LPG, in kcal/kg'.

(*Page* 5, *Annex* B, *clause* **B-2.1**, *line* 8) — Substitute 'as near as possible' *for* 'as near the possible'.

(*Pages* 6 *and* 7, *legend below Figure* 1 *and* 2 *at Sl No.* 13 *and* 14) — Substitute 'WATER HEATER' *for* 'GEYSER'.

(*Page* 8, *Annex* C, *clause* **C-1.1**, *line* 8) — Insert word 'possible' *after* 'as near as'.

(*Page* 10, *Annex* E) — Insert the following Annex at the end and renumber the existing 'ANNEX E' as 'ANNEX F':

ANNEX E

(*Clause* 9.2)

METHOD OF TEST FOR FLAME FAILURE DEVICE

E-1 PROCEDURE

E-1.1 Opening — With the appliance cold and the main gas turned off, turn on the gas burner and ignite the pilot jet, if provided. Turn on the main burner tap/taps and water taps, if necessary. Note the time required for ignition of gas in main burner (or from ignition of pilot to the ignition of gas in main burner, where pilot is provided).

E-1.2 Closing and General Soundness — Allow the device to attain equilibrium temperature with the appliance regulated to the manufacturer's instructions. Without disturbing any of the controls, extinguish the flame by means of air blow. Try to ignite the burner by applying an external flame to the burner jets/ports. Ensure that the gas supply is cut-off within closing time limits prescribed in clause **14.1**(d) of IS 5116. There should not emerge from the burner jets/ports or any parts of the device enough gas to be ignited and the total gas leakage should not exceed 1.5 l/h at the standard pressure using LPG.

(ME 23)

Reprography Unit, BIS, New Delhi, India

Indian Standard

MINI DOMESTIC WATER HEATER FOR USE WITH LPG — SPECIFICATION

1 SCOPE

1.1 This standard covers the requirements for instaneous and continuous production of hot water for domestic use, of nominal useful less than 25 kW (based on gross calorific value), for use with liquefied petroleum gases (LPG) at a working pressure of 2.942 kN/m^2 (30 gf/cm^2). It is an inlet water controlled appliance. It specifies the main constructional and performance characteristics for the instantaneous domestic water heater. It also sets the appropriate test methods for evaluating test characteristics. Appliances for boiling water are not covered in this standard.

1.1.1 For convenience, this standard has been divided into three sections as follows:

Section 1	Construction
Section 2	Performance Requirements
Section 3	General

2 REFERENCES

The following standards contain provisions, which through reference in this text constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
554 : 1999	Pipe threads where pressure-tight joints are made on the threads — Dimensions, tolerances and designation (*fourth revision*)
2305 : 1988	Method for mercurous nitrate test for copper and copper alloys (*first revision*)
5116 : 1996	Domestic and commercial equipment for use with LPG — General requirements (*third revision*)
6480 : 1988	Glossary of terms relating to domestic and commercial gas-burning appliances (*first revision*)

3 TERMINOLOGY

3.1 For the purpose of this standard, relevant definition given in IS 6480 shall apply and the following shall apply.

3.2 Instantaneous Gas Water Heater — An appliance where the heating of water is directly dependent on the draw off.

3.3 Appliance with Sealed Combustion Circuit — An appliance for which the combustion circuit (air intake, combustion chamber, exchanger, products outlet) is sealed in relation to the place where the appliance is installed. The appliance is either connected to a special device in the outer wall by two ducts, one bringing in the combustion air and one evacuating the products of combustion or connected to a common duct bringing in the combustion air and evacuating the products of combustion.

3.4 Thermal Efficiency — The ratio of the useful output to the heat input, these two quantities being expressed in the same unit.

3.5 Electrical or Electronic Equipment — Embraces the parts of an appliance, including their connections, which work by electricity.

3.6 Flame Stability — The state of the flames resting in stable manner on the burner ports with no danger of flame lift or flash back.

3.7 Gas Rates

a) *Volume Rate* — The gas passed in unit time corrected to the reference conditions at 27° C and 760 mm Hg.

b) *Mass Rate* — The mass of gas passed in unit time under reference conditions.

NOTE — The rates are determined in the steady state condition when all the parts have reached thermal equilibrium.

3.8 Ignition Device — A device to ignite one or more burners.

NOTE — It may be, for example, either electric or a pilot flame.

3.9 Nominal Water Rate — The rate of water, in litres per minute, obtained with the nominal useful out put of appliance, for temperature rise of 25°C.

3.10 Useful Output — The quantity of heat absorbed by the water drawn off, during unit time.

3.11 Water Pressure — The relative static pressure measured at the water in-let connection of the appliance.

3.12 Water Rate Adjuster (for the Outlet) — A device allowing water rate to a pre-determined value according to supply conditions.

3.13 Inlet Water Control Appliance — The draw off tap is placed up stream of the appliance, which is designed to deliver a free flow of water.

SECTION 1 CONSTRUCTION

4 GENERAL REQUIREMENTS

4.1 In addition to the relevant requirements given in 4 of IS 5116, the requirements given in **4.1.1** and **4.1.12** shall apply.

4.1.1 No LP Gas (low pressure) regulator shall be included as a part of the heater.

4.1.2 All parts in contact with water shall be made of materials of such quality, which shall not pollute the water.

4.1.3 All parts shall be made and so assembled that the performance characteristics of an appliance will not alter significantly during a reasonable life and in normal conditions of installations and use.

4.1.4 It shall be possible to clean without difficulty the combustion chamber and walls in contact with the products of combustion.

4.1.5 It shall not be possible to replace parts, which are removable for maintenance in a way that could impair the safe performance of the appliance.

4.1.6 The gas and water soundness shall be assured after reassemble maintenance.

4.1.7 It shall be possible to install an appliance intended to be fixed to a wall with appropriate means of fixing, such as clamps, hooks, screws, etc.

4.1.8 All parts of water heaters subject to direct heat shall have brazed or welded joints. Interior surfaces shall be of such material, or so protected, as to avoid contamination of the contents.

4.1.9 The gas (heat) input to the pilot alone shall not exceed 8 l/h at a gas inlet pressure of 30 gf/cm^2 and at temperature 25°C to 30°C, wherever applicable.

4.1.10 The appliance shall be provided with a safety device, which cuts off the supply of gas in case water does not flow or stops flowing while in operation.

4.1.11 The water heater shall have a provision such that supply of gas shall be cut off and the burner extinguished after 20 min of uninterrupted use. The appliance shall able to restart manually.

4.1.12 All heat exchanger tubes through which the water passes and water chamber, if provided, shall be completely filled with water before igniting the burner.

5 MATERIAL

5.1 The materials used in the construction of the water heater shall be resistant to wear and deterioration occurring in the normal use.

5.2 The copper and copper alloy parts shall pass the mercurous nitrate test (season cracking test) when tested according to the method specified in IS 2305.

5.3 Non-metallic materials normally in contact with the gas shall not change in weight or volume by more than 15 percent after being immersed in pentane or LPG for 72 h at room temperature, when tested according to Annex A.

5.4 The main body of the burner, which includes mixer head, mixing tube and burner head shall be of substantial and durable construction. Metals having melting point below 510°C shall not be used.

5.5 Diaphragms, for inlet water control device, shall be made of synthetic rubber. While choosing the material the manufacturer shall take into account the characteristics required for the satisfactory use that is, mechanical and chemical stability. Material selected shall not degrade under normal working conditions.

6 CONNECTIONS

6.1 For connections and screws other than for water, metric threads shall be used.

6.2 Gas inlet connection shall permit a rigid connection.

6.3 All gas connections shall be of copper or brass tube and have at least 6 mm inner dia and 0.5 mm wall thickness.

6.4 The water inlet and outlet connections shall be of BSP thread (*see* IS 554).

6.5 The gas and water connections shall be situated at the base of the appliance. It shall be possible to connect the appliance to supply, which are in a plane parallel or perpendicular to the wall on which the appliance is fixed.

6.6 Gas Inlet Connections

6.6.1 The water heater shall be provided with nozzle or screwed gas inlet connection as given in **18** of IS 5116.

7 FLAME VISIBILITY

All appliances shall be designed so that ignition, correct burner performance and the length of the pilot flames. if any, can always be easily seen. This visibility shall be assured at all times, and particularly, where there is a viewing window, this shall not deteriorate under the effect of heat.

8 GAS TAPS

The appliance shall have a device (gas tap) allowing manual interruption of the supply of gas to the burner and pilot, if available in case of exigency. The device shall be of such a design that gas shall not enter to the main burner and the pilot (if provided) until it is reset to the original position.

9 FLAME FAILURE DEVICE

The appliance shall have a flame failure device, controlling the admission of gas to the main burner and possibly to any ignition pilot. The provisions given in **14** of IS 5116 shall apply.

10 IGNITION DEVICE

An appliance shall have an ignition device. Where the appliance is provided in the form of a pilot it shall be possible to light it easily with a matchstick or a special ignition device. The pilot shall be positioned in such a way that its products of combustion are evacuated with those of the burner. While in operation the relative position of the pilot and burner shall not alter. The pilot burner shall be made of a material that shall not deteriorate under normal condition of use. It is essential that the pilot flame shall be seen either directly or by reflection. The ignition to the burners from pilot shall be smooth.

11 PROTECTION AGAINST ACCIDENTAL OVERHEATING

The water heater shall be provided with a suitable overheat protection device, which shall switch off the supply of gas if the temperature of the delivered water reaches 95°C. The gas supply shall be restored manually.

12 WATER RATE ADJUSTER

The appliance shall be provided with a means of adjusting water rate.

SECTION 2 PERFORMANCE REQUIREMENTS

13 GENERAL CONDITIONS OF TEST

The requirements as given in **19** of IS 5116 shall apply.

13.1 General Test Condition

13.1.1 *Test Room*

The appliance shall be installed in a well-ventilated, draught-free room which has an ambient temperature of 20 to 30°C.

13.1.2 *Accuracy of Measurements*

Except where otherwise specified, the instruments used shall permit measurements to be made with the following accuracy:

Parameters		*Accuracy Required*
Water temperature, °C	:	± 0.5
Surface temperature, °C	:	± 2
Gas temperature, °C	:	± 0.5
Gas volume, percent	:	± 0.5
Time, s	:	± 0.5
Weight, percent	:	± 0.1
Test gas pressure, gf/cm^2	:	± 0.3
Water pressure, percent	:	± 2
Test air pressure, percent	:	± 2
Atmospheric pressure, gf/cm^2	:	± 1

14 GAS SOUNDNESS

The relevant requirement given in **16** of IS 5116 shall apply.

15 WATER SOUNDNESS

The water circuit of the appliance shall not leak or show any permanent distortion during or after the test when tested at a hydrostatic pressure 4 kgf/cm^2. The water circuit shall be kept under pressure for minimum 5 min.

16 THERMAL EFFICIENCY

When tested as prescribed in Annex B of this standard, the thermal efficiency of the water heater shall not be less than:

a) 84 percent for water heaters with a nominal heat input exceeding 10 kW, and

b) 82 percent for water heaters with a nominal heat input not exceeding 10 kW.

17 COMBUSTION

When tested as per Annex C of this standard on no account the carbon monoxide/carbon dioxide ratio of exhaust gases while operating at any consumption at which burner is stable at gas inlet pressure from 25 gf/cm^2 to 35 gf/cm^2 shall exceed 0.02.

18 GAS CONSUMPTION

With the taps fully opened and with the burners operating at the maximum consumption, the appliance shall give within ±5 percent of the manufacturer's recommended gas consumption in g/h or heat input in kcal/h at 2.942 kN/m^2 (30 gf/cm^2) gas inlet pressure, when tested as per **20.4** of IS 5116 at STP (by using air and then converting to LPG).

19 IGNITION AND FLAME TRAVEL

19.1 There shall be easy and safe access for lighting the pilot burner by a matchstick and it shall be easy to see that the burner or burners is lighted from the pilot. Where the burner or burners are lighted by automatic ignition, it shall not be possible for gas to be admitted to the main burner without being smoothly ignited.

19.2 If the flame is applied to any one burner port, when the gas is flowing, flame travel shall be complete. This applies for all pressures from 25 gf/cm^2 to 35 gf/cm^2, taps being fully open.

19.3 If the burner is ignited from a pilot flame, ignition shall be smooth at pressures from 25 gf/cm^2 to 35 gf/cm^2 with the tap turned full on and ignition shall be effected without delay after turning on the taps.

20 FLAME STABILITY

It shall be possible to operate the appliance with tap fully open at gas inlet pressure from 2.452 kN/m^2 to 3.432 kN/m^2 (25 gf/cm^2 to 35 gf/cm^2) without the flame either extinguishing, blowing off or striking back and without the formation of soot. The pilot flame shall be stable, without lifting or soot deposition, at this gas inlet pressure.

21 NOISE CONTROL

The ignition of the burner flame, their operation and turning off shall not give rise to undue or excessive noise during all the operation tests.

22 FLASH-BACK

While the appliance is in operation at full gas consumption, and the appliance is in thermal equilibrium the flame shall be immediately reduced to the minimum possible and then brought back to the full size. The operation shall be repeated five times. No flash-back shall occur during the test. This applies for all pressures from 25 gf/cm^2 to 35 gf/cm^2.

23 RESISTANCE TO DRAUGHT

There shall be no extinction of the flame on any of the burners operating at maximum consumption when the appliance is placed in a normal (not localized) current of air with a velocity of 2 m/s, as measured with a rotating vane anemometer. The location of the appliance relative to neighboring walls and the direction of the draught shall be varied to correspond to likely conditions of appliance installation. This applies for all pressure from 2.452 kN/m^2 to 3.432 kN/m^2 (25 gf/cm^2 to 35 gf/cm^2).

24 FIRE HAZARD AND LIMITING TEMPERATURE

The relevant requirements given in **23** of IS 5116 shall apply.

25 TIME FOR TEMPERATURE RISE

When tested as per Annex D of this standard, at the nominal gas rate with the appliance adjusted to give a temperature rise of 50°C between the water inlet and outlet, the time to achieve 90 percent of this temperature rise shall not exceed 25 s.

SECTION 3 GENERAL

26 INSTRUCTIONS

The appliance shall be accompanied by an instruction sheet with the relevant instructions given in **24** of IS 5116.

27 MARKING

27.1 Each appliance shall be legibly and indelibly marked with the following:

a) Manufacturer's name, initials or registered trade-mark;
b) Serial number;
c) The words for use with liquefied petroleum gas (LPG) at 2.942 kN/m^2 (30 gf/cm^2);
d) The total gas consumption at 30 gf/cm^2;
e) Hot water output, in litres/min;
f) **Warning — 'For use in well ventilated areas only'** — To be written on the front of the body of the appliance in Red Colour as well as prominently on the outer package;
g) Any special instructions for safe operation;
h) Country of origin;
j) Temperature chart corresponding to the thermostat setting, if thermostat is provided; and
k) Minimum water head required for operation of the water heater.

NOTE — The information given in marking shall be distinct, permanent and easily accessible when the appliance is installed.

27.2 BIS Certification Marking

The appliance may also be marked with the Standard Mark.

27.2.1 The use of the Standard Mark is governed by the provisions of *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder. The details of conditions, under which a license for the use of the Standard Mark may be granted to manufacturers or producers, may be obtained from the Bureau of Indian Standards.

28 PACKING

28.1 The appliances shall be packed in such a way that, there is no damage during transit.

28.2 All open pipe ends and connections openings shall be suitably plugged, and sealed to prevent the entry of extraneous matter.

ANNEX A

(*Clause* 5.3)

METHOD FOR DETERMINATION OF SWELLING OF NON-METALLIC MATERIALS

A-1 PROCEDURE

Weigh a piece of material under examination in air and then in water and calculate the volume. Thereafter, immerse in pentane for 72 h at a room temperature. In case liquid pentane is not available, immerse piece in LPG. After 72 h, withdraw the sample and allow to weather in air for 5 min and reweigh in air and in water for estimation of volume.

In case of loss of weight, care shall be taken not to confuse it with the removal of small bits of grease, which may have been present in the sample under test. If this is suspected, perform the test on two samples, wash one of them for a few minutes in liquid pentane before commencing the test. If deterioration in the properties of the compound are suspected as a result of loss of weight, then dismantle all the components, subject them to the test as described above and then reassemble and test for operation in the usual way.

ANNEX B

(*Clause* 16)

THERMAL EFFICIENCY

B-1 PROCEDURE BY VOLUME METHOD

B-1.1 Thermal efficiency is determined under the following conditions:

The appliance shall be set in the manner with a suitable device for measuring gas consumption and inlet pressure of the gas. A wet gas meter which is commonly used for this shall set up in series and a manometer in parallel with the appliance under test (*see* Fig. 1).

B-1.2 A typical test setup is shown in Fig. 1. LPG shall be passed at 2.942 kN/m^2 (30 gf/cm^2) inlet pressure through the setup for a few minutes to purge the system of air and to establish the pressure required. Inlet water tap is opened and water is admitted to the equipment till it comes through the outlet. Then the equipment is lighted. Adjust the water flow and the flame setting in such a way that the rise in water temperature is 20 ± 2°C. After the outlet temperature stabilizes, start the stopwatch. Simulanetaneously note down the flow meter reading V_1, inlet and outlet temperatures and keep an empty container at the outlet to collect the hot water. From this moment onwards, the controls of the water heater should not be altered till completion of the test. The inlet and outlet water temperature is measured in every 2 min and recorded. During the course of this test in total six readings shall be recorded. During this period, if the temperature of the inlet or outlet is beyond the specified limit, the test shall be discarded. Precaution should be taken to ensure that the measuring device does not cause any thermal loss. The hot water is collected in the container. At the end of the tenth minute the inlet water-tap and the gas-tap are closed, so as to stop the flow of water and to put-off the burner. Remove the cylinder and record final reading of the flow meter V_2. The thermal efficiency in percentage shall be calculated by the following formula:

$$e = \frac{100\,M\,(t_2 - t_1)}{(V_2 - V_1)\,H}$$

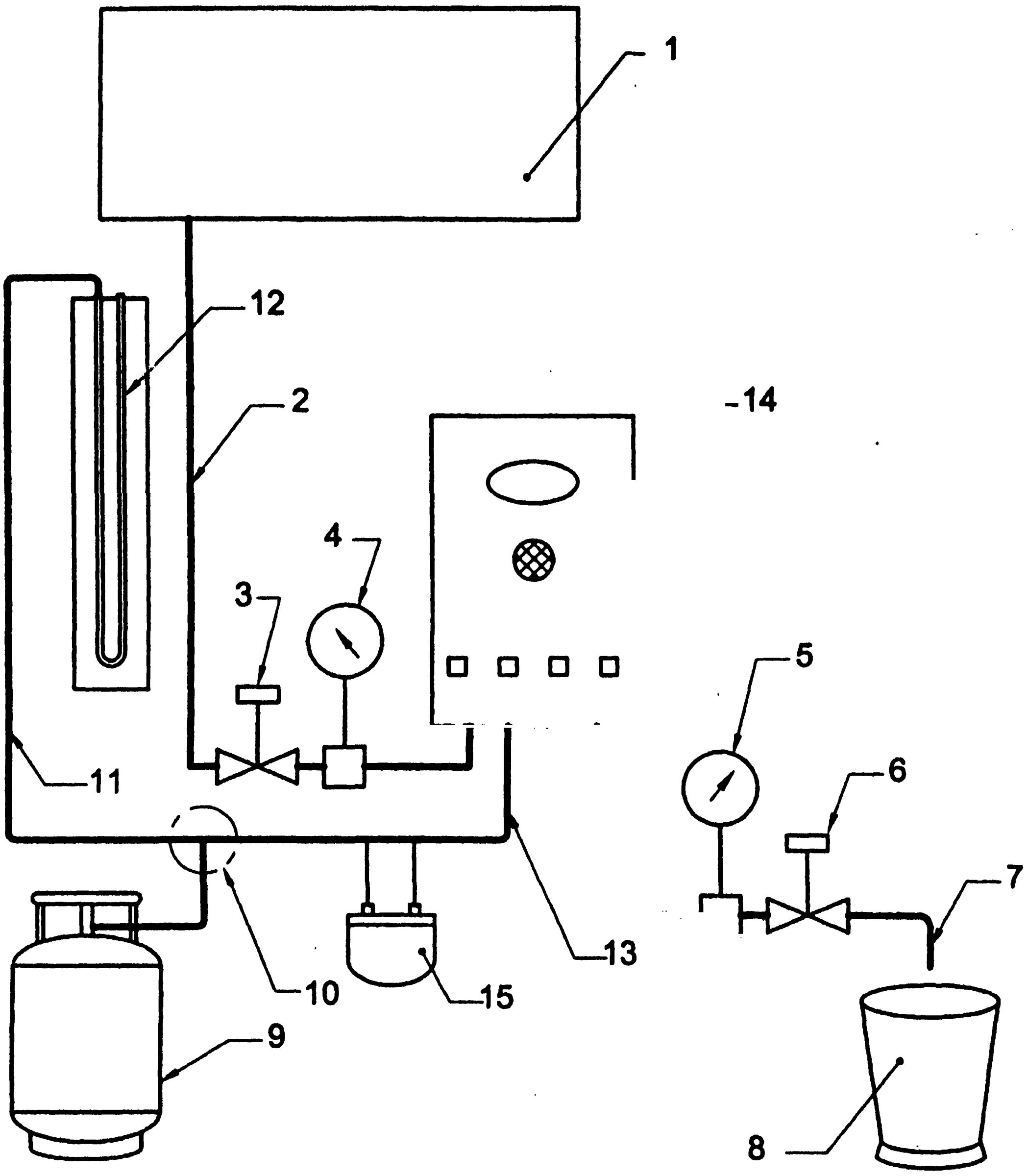
where

e = thermal efficiency;
M = quantity of water heated during the test;
V_1 = initial reading of the flow meter, in litres;
V_2 = final reading of the flow meter, in litres;
t_2 = final temperature of water, (average of the six readings) in °C;
t_1 = initial temperature of water, (average of the six readings) in °C; and
H = calorific value of LPG, in kcal/kg (26.8 kcal/litres).

B-2 ALTERNATE METHOD (PROCEDURE BY WEIGHT)

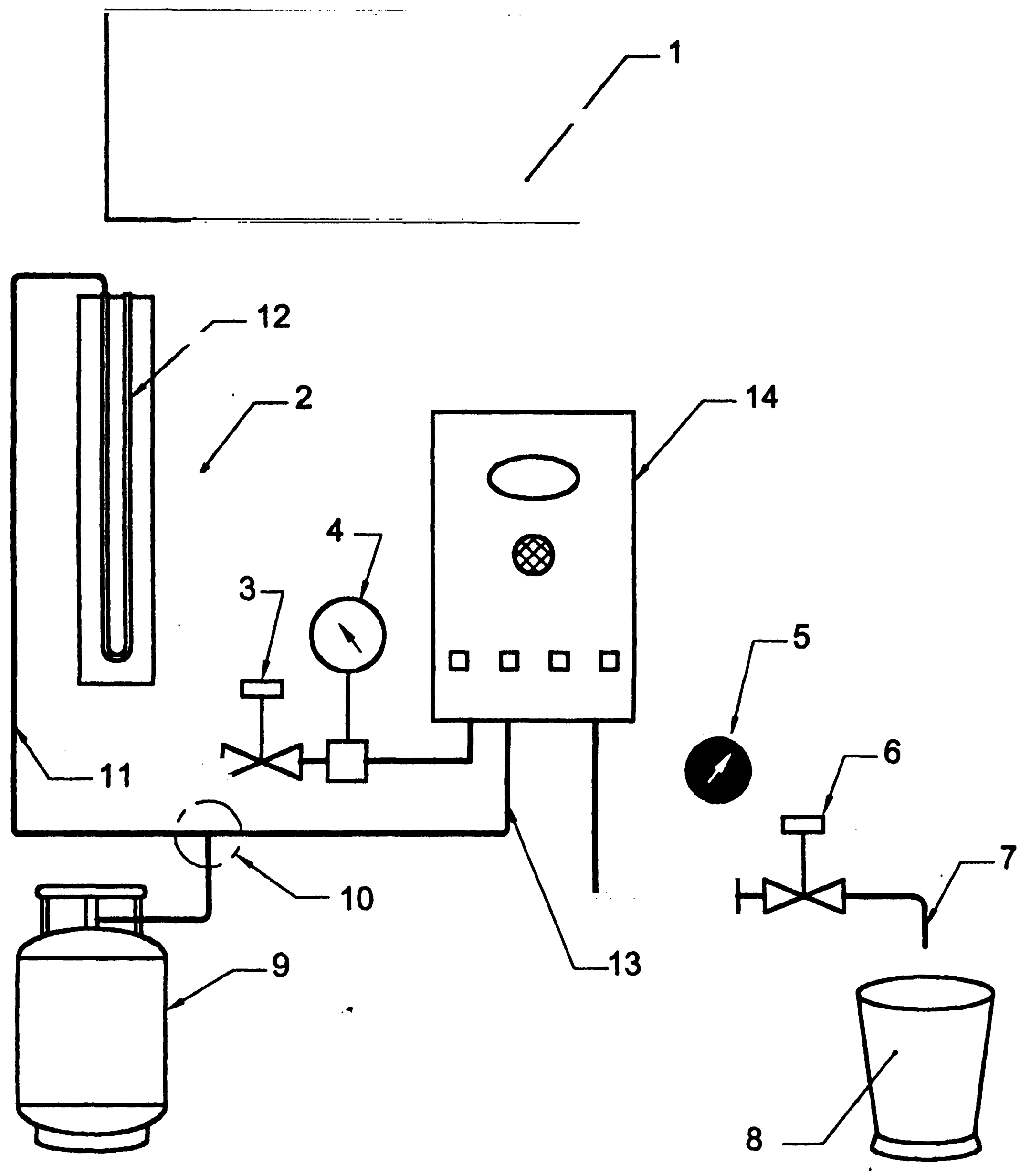
B-2.1 The test may also be done by weighing the gas used, instead of measuring consumption by volume. The gas is taken in a small bottle of liquid weighing 1 kg or 2 kg. The bottle is fitted with an 'ON/OFF' valve and is connected to a regulator which, in turn, is connected to a pressure gauge and to the appliance. A second 'ON/OFF' gas valve shall be inserted in the gas way up stream of the regulator as near the possible to the gas bottle. A typical sketch of the setup necessary for this test is shown in Fig. 2.

B-2.2 LPG shall be passed at 2.942 kN/m^2 (30 gf/cm^2)



1) OVER HEAD WATER TANK	9) LPG CYLINDER
2) IN COMING WATER PIPE LINE	10) TEE FITTING
3) SHUTOFF VALVE	11) GAS PIPE LINE TO MANOMETER
4) INLET TEMPERATURE MEASURING DEVICE	12) WATER IN GLASS MANOMETER
5) OUTLET TEMPERATURE MEASURING DEVICE	13) INLET LPG LINE TO THE GEYSER
6) SHUTOFF VALVE	14) LPG GEYSER
7) HOT WATER OUTLET	15) LPG FLOWMETER
8) HOT WATER RECEIVER	

FIG. 1 THERMAL EFFICIENCY BY VOLUME METHOD



1) OVER HEAD WATER TANK
2) IN COMING WATER PIPE LINE
3) SHUTOFF VALVE
4) INLET TEMPERATURE MEASURING DEVICE
5) OUTLET TEMPERATURE MEASURING DEVICE
6) SHUTOFF VALVE
7) HOT WATER OUTLET
8) HOT WATER RECEIVER
9) LPG CYLINDER
10) TEE FITTING
11) GAS PIPE LINE TO MANOMETER
12) WATER IN GLASS MANOMETER
13) INLET LPG LINE TO THE GEYSER
14) LPG GEYSER

FIG. 2 THERMAL EFFICIENCY BY WEIGHT METHOD

inlet pressure through the setup for a few minutes to purge the system of air and to establish the pressure required. Inlet water-tap is opened and water is admitted to the equipment till it comes through the outlet. Then the equipment is lighted. Adjust the water flow and the flame setting in such a way that the rise in water temperature is 20 ± 2°C. After the outlet temperature stabilizes, cutoff the supply of water and gas. After this, the controls of the water heater should not be altered. The cylinder shall be disconnected, weighed (w_1) and reconnected. The water inlet tap is opened and water is filled in the appliance to be tested. Then the tap is closed. The gas control tap shall then be opened and gas is ignited and simulanetaneously open the inlet and the outlet water taps and start the stopwatch. The difference between the inlet and the outlet water temperature should be 20 ± 2°C. The inlet and the outlet water temperature is measured in every 2 min and recorded. During the course of this test in total six readings shall be recorded. During this period, if the temperature of the inlet or outlet is beyond the specified limit, the test shall be discarded. Precaution should be taken to ensure that the measuring device does not cause any thermal loss. The hot water is collected in the container. At the end of the tenth minute the inlet water-tap and the gas-tap are closed, so as to stop the flow of water and to put-off the burner. Remove the cylinder and record final weight (w_2). The thermal efficiency percentage shall be calculated by the following formula:

$$e = \frac{100\, M\, (t_2 - t_1)}{WH}$$

where

e = thermal efficiency;

w_1 = initial weight of gas cylinder, in kg;

w_2 = final weight of gas cylinder, in kg;

W = $w_1 - w_2$ = Quantity of gas consumed by the appliance during the test in kg;

M = quantity of water heated, in kg;

t_2 = final temperature of water (average of the six readings), in °C;

t_1 = initial temperature of water (average of the six readings), in °C;

H = calorific value of LPG (10 900 kcal/kg).

B-3 In performing the thermal efficiency test the following conditions shall be noted:

a) The setup shall be carefully checked for leak, before and after the test. If leak is found after the tests, the results should be cancelled and the test repeated.

b) It may be necessary to place a screen around the appliance during this test in order to exclude the effects of draught.

c) The initial temperature of the room shall be between 20 and 30°C. The water temperature shall be within ± 2°C of the actual room temperature.

d) The net calorific value of gas is used. If this is not determined experimentally, the value may be taken as 10 900 kcal/kg for calculation when determined by weight method and 26.8 kcal/litres, when determined by volume method.

e) For conducting thermal efficiency test, gas from the commercial cylinder (bottle) of LPG, the first two-thirds of which has been allowed to evaporate (to waste or in vapour withdrawal use), the remaining one-third shall be used for test. The use of last 1 or 2 kg of gas shall be avoided as this may contain heavy ends.

ANNEX C

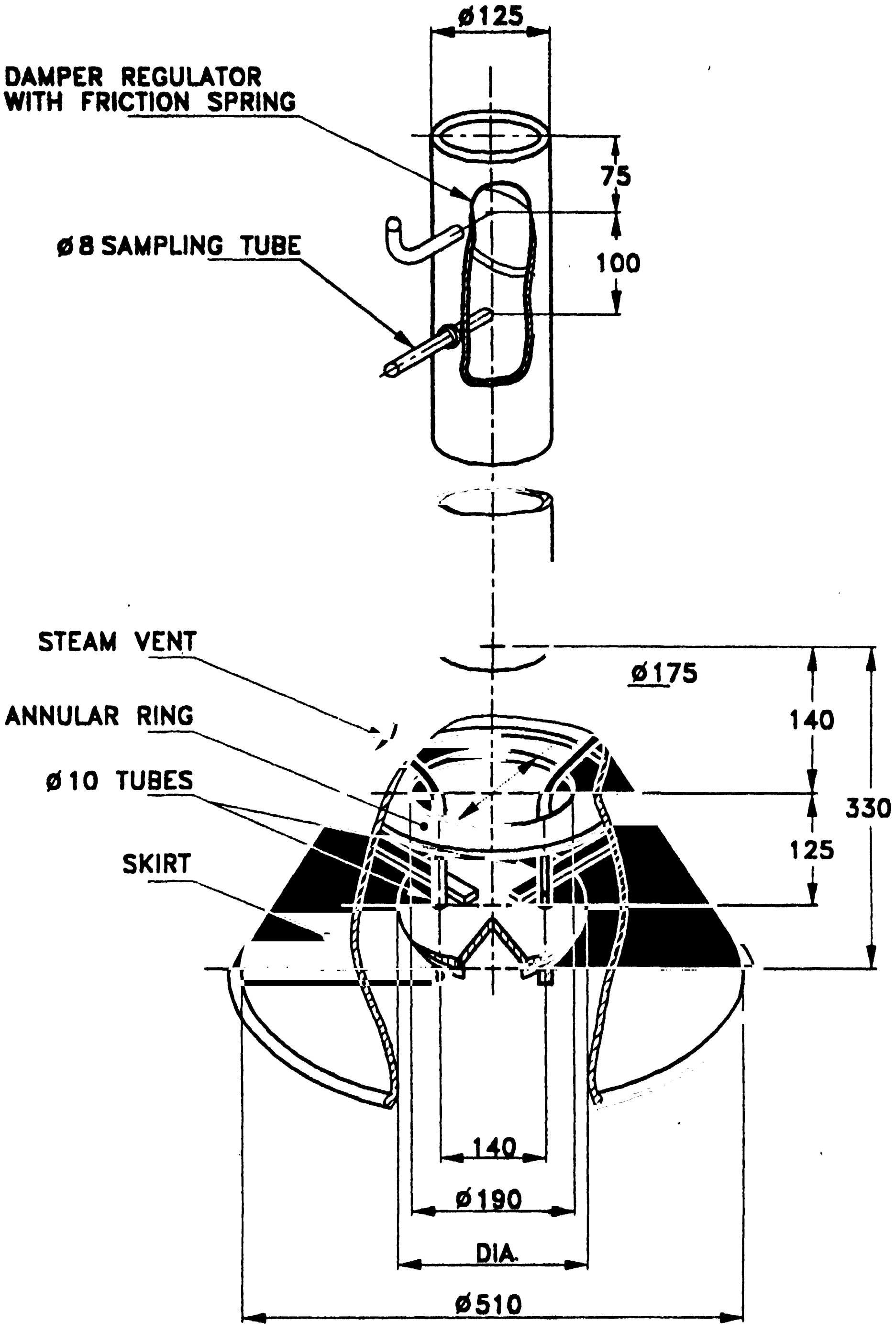
(*Clause* 17)

COMBUSTION EFFICIENCY

C-1 PROCEDURE

C-1.1 The water heater shall be filled to its normal capacity, with the thermostats, if any, at the maximum setting, the burner shall be lit and a sample of the flue gases be taken at the flue spigots or at the out let end of the primary flue, after 10 min of lighting and when the appliance is at the thermal equilibrium. The sample of products of combustion is taken by an aspiration probe placed as near as to the flue outlet of the collecting hood (*see* Fig. 3). Carbon monoxide can be measured by using infra-red instruments or Iodine pentoxide method and Carbon dioxide can be measured by using Orsat type appliances.

C-1.2 When sampled as detailed above the carbon monoxide and carbon dioxide ratio of the products of combustion shall not exceed 0.02 at any rate between the normal maximum gas rate and the prescribed over load rate. This requirement shall be achieved for all pressures from 2.452 kN/m² to 3.432 kN/m² (25 gf/cm² to 35 gf/cm²) using LPG. Tests shall be made at a sufficient number of heat input rates to determine the combustion performance over the whole of the prescribed range.



All dimensions in millimetres.

FIG. 3 HOOD FOR GUIDANCE

ANNEX D

(*Clause* 25)

TEMPERATURE RISE TEST

D-1 PROCEDURE

D-1.1 The appliance is installed as given for thermal efficiency test. The outlet water temperature is measured with a rapid indicating mercury thermometer. The ambient (room or surrounding) temperature shall be higher than the inlet water temperature. Both are recorded.

D-2 The water rate is adjusted so that the temperature rise with the appliance at thermal equilibrium is 45 ± 5°C for the normal heat input. When this equilibrium has been reached the gas supply to the burner is cut off, but without modifying the water rate. As soon as the outlet water temperature is approximately the same as the inlet water temperature, the gas-way to the burner is re-opened and the pilot re-lit if necessary. From the moment that gas reaches the main burner, the time is measured until the equilibrium temperature has risen by 90 percent of the temperature rise at thermal equilibrium.

ANNEX E

(*Foreword*)

COMMITTEE COMPOSITION

Composition of Domestic and Commercial Gas Burning Appliances Sectional Committee, ME 23

Organization	*Representative(s)*
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